DOCUMENT RESUME

ED 381 003 FL 022 829

AUTHOR Cahill, Mike
TITLE Nasal Assimilation and Labiovelar Geometry.
PUB DATE Mar 95
NOTE 19p.; Paper presented at the Annual Conference on African Linguistics (March 24-26, 1995).
PUB TYPE Reports - Evaluative/Feasibility (142)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *African Languages; *Articulation (Speech); *Language Patterns; Language Research; Linguistic Theory; *Phonology; Uncommonly Taught Languages
IDENTIFIERS Gur Languages

ABSTRACT

The representation of labiovelars in feature geometry is discussed, using primarily evidence from Konni, a Gur language of northern Ghana, and data from some other languages. The discussion is based on an observation that place assimilation of a nasal consonant to labiovelars does not result universally in a labiovelar nasal, as has been theorized previously. Relevant data from Konni are presented first, and two possibilities for analysis of Konni and other languages are considered and rejected. Various proposals in the literature about how labiovelar consonants and nasal assimilation are to be represented in feature geometry are reviewed. An analysis to explain the assimilation facts in these cases is then outlined. It is concluded that to account for the facts of nasal assimilation in these languages, a geometrical representation must allow for both partial and total place assimilation. The facts of nasal assimilation suggest that a partial place assimilation is not unrestricted, but assimilates to the primary place of articulation if the language makes a distinction between primary and secondary places. A model of geometric identification is identified that, along with two separate rules for nasal assimilation, accounts best for the facts. Contains 23 references. (MSE)

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ED 381 003

Nasal Assimilation and Labiovelar Geometry

Mike Cahill

ACAL 26

March 24-26, 1995

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1. Introduction

Sagey (1990) was the first to attempt a representation of labiovelar stops /kp, gb/ in feature geometry. In keeping with her idea of what the representation of these stops is, she wrote that the place assimilation of a nasal consonant to labiovelars results in a labiovelar nasal [ŋm]. This was borne out in cases from several languages (pp. 71-72). However, this assimilation is not universal; several languages manifest [ŋ] before [kp, gb] rather than [ŋm], at least word-internally. Kɔnni, a Gur language of northern Ghana, has a particularly interesting system in which a nasal is [ŋ] before a labiovelar word-internally, but [ŋm] before a labiovelar across word boundaries.

This raises questions about how labiovelars are to be represented in a feature geometry.

In Section 2 of this paper, I will present the relevant data from Kɔnni and other languages. Next, in Section 3, I will examine two possibilities for analysis of Kɔnni and reject them. In 4, I will examine various proposals in the literature about how labiovelar consonants and nasal assimilation are to be represented in feature geometry. In Section 5 I will propose an analysis to explain the assimilation facts, and conclude with some closing remarks in Section 6.

2. The data[1]

Sagey (1990) cites several languages (Kpelle, Yoruba, Dan, as well as several others with prenasalized labiovelars) in which a nasal before a labiovelar is manifested as [ŋm]. To these I can add:

(1) Gɪdɪrɛ (or Adele) (Kleiner 1989) The prefixes below are noun class prefixes.

ŋ̀m-gbùntoo	'carried thing'	dɪ̀-gbòŋmgbo	'gong'
ŋ̀m-kpa	'life'	e-kɔ́ŋmgbélɪ̀-lɛ́	'rival'

However, there are several, perhaps many, languages, in which a nasal before a labiovelar is manifested as [ŋ], as Ryder (1987) has pointed out. Most of the cases below are spoken in or near Ghana.

2.1 Gur Languages

(2) Birifor (Kuch in press):

kpaŋkpam	'upper arm'	gbaŋgbo	'axe'
lɔŋkpɛ:	'frog-big (big frog)'	suŋgbulo	'bambara beans'

[1] The Kɔnni data is phonemic, with the exception of the nasals under consideration, which are all phonetic. Data from other languages is cited as reported in the literature.

(3) Dagaari (Kennedy 1966):

kpàŋkpàŋ	'upper arm'	gbáŋgbáŋ	'noon'
niŋkpíe	'strong man'	bɔ̀^{h}líŋgbe^{h}	'soup leaf'
(personal data)			
ŋ́ kpanɔ̀	'I lock'	ŋ̀ kpìéra	'I am entering'

(4) Dɛg (Crouch in prep)[2]

béŋkpóŋʌ	'one by one'	kʊ̀ŋkpég?	'strong thing'
dàŋgbàlá	'walking stick'	dʌŋgbòŋʌ	'mouse'

(5) Hanga (Hunt 1981):

naŋgbanni	'mouth'

(6) Konkomba (Steele & Weed 1966):

kínìŋgbûŋ	'skin'	ŋ́kpàl	'a cough'
ŋgbéèm	'full'	útʃíĩŋkpân	'worm'
ĩtákpàlâŋgbàl	'sky'		

(7) Kusaal (Spratt & Spratt 1968):

nɪŋgbɔŋ	'skin'

(8) Vagla (Crouch & Smiles 1966)

tʃaŋkpalna	'antelope'	sʌŋgbo	'baboon'

2.2 Other Niger-Congo Languages

(9) Anufo (Chakosi) (Stanford 1970):

laeŋkpetɛ	'wing'	daŋgba	'dirt'
ŋgbɛ	'empty'		

(10) Chumburung (or Nchimburu) (Price 1975):

ŋkpɪnɔ	'chests'	ɲeŋkpàsɛ	'person'

(11) Ga (Ryder 1987)

ŋgbekɛ	'my child'	ŋkpal	'my cheeks'
taaŋkpee	'sisal'		

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[2] Besides the [ŋ] before labiovelars listed above, the manuscript also includes:

dʒɔ̀mgbɔ́l?	'a cloud'	tʃa̰mgbɛrɛ	'a broom'

Crouch (personal communication) informs me that these data are not definitely confirmed. One possibility is that the phonetic sequence is actually [ŋmgb]. If these words are compounds, then there is a situation partly parallel to the Kɔnni case below, in which there is partial place assimilation of a nasal on one level, and total place assimilation of a nasal on another level.

(12) Efik (Ohala & Ohala 1993)

"the nasal assimilating to this /kp/ sometimes manifests itself as the [-anterior] nasal [ŋ] (when it is not [ŋm].)"[3]

In summary, a nasal consonant manifests itself before a labiovelar consonant in one of only two ways: as [ŋ] or [ŋm]. [4]

2.3 Kɔnni

I will examine the Kɔnni case in more detail, since it offers an interesting variation on the above data. Much of the Kɔnni data below is from Cahill (1992), but I supplement it from my field notes as well. High tone is marked with acute accent; low tone is unmarked.

Kɔnni has five nasal phonemes:

(13) Nasal phonemes of Kɔnni:

/m/	mana	'all'	memíe	'rice'
/n/	náŋ	'leg'	tana	'stones'
/ɲ/	ɲaáŋ	'water'	haɲí	'funeral dance'
/ŋ/	ŋáa	'listen!'	nɪŋa	'front'
/ŋm/	ŋmáána	'okra'	dʒɪŋmíŋ	'evening'

As in the other languages under consideration, Kɔnni has a rule in which nasals assimilate in place of articulation to a following consonant: [5]

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[3] Published reports as well as Field Methods notes from OSU students are inconsistent in their transcriptions of nasals before labiovelars. There is a possibility that a nasal assimilates to a labiovelar as either [ŋ] or [ŋm], as in the Kɔnni case below. Welmers (1973:47) notes that "For some unknown reason, in the usual orthography of Efik, *mkp* is written in some cases but *ŋkp* in others." Without further investigation no definite conclusions can be reached.

[4] Essien (1990) reports for Ibibio that "in the case of the labiovelar, /n/ assimilates to either the [k] as in ŋ̀kpɔ́ 'something' and sometimes to the [p] as in the case of *mkpa:* 'death.'" (Essien 1990:20, his italics) He also state that mkpá 'a tree with edible leaves,' is sometimes pronounced as ŋ̀kpá. At this point, I am not sure what to make of these variations, especially since Essien does not mention the possibility of [ŋm], which is a good candidate to get confused with [m] in these contexts.

[5] I have not been able to consistently distinguish [n] and [ɲ] before a palatal consonant /y, dʒ, tʃ/. Therefore any nasal before palatal consonants is transcribed as [n]. I mention this for completeness' sake, but it does not affect any argument of this paper.

(14) Nasal assimilation before simple stops in Kɔnni:

a)	m̩ balɪ-yá	'I have told'	m̩ bííŋ	'my goat'
	n̩ dɔgɪ-yá	'I have carried'	n̩ túma	'my work'
	ŋ̩ kalɪ-yá	'I have sat'	ŋ̩ kuáŋ	'my farm'
b)	ɲím mana	'everything'	démbíŋ	'man'
	ɲín-dikke	'eaten things (food)'	dantɪ-ma	'greet!'
	ɲíŋ-kɔla	'big things'	koŋkógiŋ	'mountain'

The interesting point comes when a nasal precedes a labiovelar consonant /gb, kp/. Then there are two ways a nasal assimilates to the consonant, depending on whether there is a word boundary between them or not:

(15) First type of nasal assimilation -- [ŋ] before a labiovelar within words:

a) Single-morpheme words:

tɪŋgbáŋ	'floor'	kɔ́ŋgbáŋ	'ant-lion'
bɪŋkpɪáŋ	'shoulder'	saŋkparíŋ	'navel'

b) Compound nouns:

haŋ-gbaáŋ	'hyena ("bush-dog")'
nyɪŋ-gbánín	'body ("front-skin")'

c) Noun-adjective:

duúŋ-kpɪ́ŋ	'big horse ("horse-big")'
bíŋ-kpɪ ˈáŋ	'dry seed ("seed-dry")'

(16) Second type of nasal assimilation -- [ŋm] before a labiovelar across words:

a) Pronoun

ŋm gbiéŋ	'my pot'	**ŋm** kpallí	'my calabash'
ŋm gbálígí-ya	'I've gotten tired'	**ŋm** kpátí-ya	'I've finished'

b) Noun Phrases:

sɪŋkpáá**ŋm** ˈkpááŋ	'peanut oil'	(cf. sɪŋkpááŋ)

c) Verb Phrases:

kéŋ**m** kpátɪ	'come finish'
kéŋ**m** gbírígɪ	'come kneel'

Note: The above are at normal speech rates, but at least some of these are ŋ in more careful speech.

3. Possible but Non-plausible Solutions for Kɔnni

Before considering the broader language situation, I will consider and reject two possible explanations of the Kɔnni data, that is, that a nasal preceding a labiovelar is [ŋ] within words and [ŋm] across words.

3.1 Assimilation takes place only across word boundaries

One suggestion for the different manifestations of Kɔnni nasals is that there is no actual assimilation at all word internally. That is, the reason /N/ does not assimilate to /kp/ as [ŋm] is that nasals do not assimilate to the following consonant's place within words. This would explain why there is a different manifestation of a nasal before a labiovelar within word and across words. Across words, there is place assimilation, but not within words.

There are problems with this approach, however. As seen in (13), the nasals [m, n, ŋ] all occur word-internally before an obstruent. These are all independent phonemes. However, /ŋm/ is also phonemic. It is extremely improbable that all the nasals except one would occur word-internally before consonants. Also, every one of these nasals are homorganic with the following consonant's place of articulation, except for the case of Kɔnni [ŋ] before labiovelars, and even that can be looked on as a partial assimilation.

The simplest solution/assumption is that the nasal consonants do in fact assimilate to following consonants here, as in a multitude of other languages.

3.2 Nasal Simplification within a word

Another possibility why a nasal is not manifested as a labiovelar nasal before labiovelars is that it has been simplified. That is, we could assume complete assimilation, but for some reason the cluster [ŋmgb] is simplified to [ŋgb].

There is no plausible motivation for such a process. Labiovelars in Kɔnni and related languages act as single consonants phonologically, so phonologically speaking (not phonetically), there is no simplification here - we would be replacing one NC cluster with another NC cluster.

Structure preservation may be appealed to, but it also does not really provide any explanation here. /ŋm/ is a phoneme in its own right in Kɔnni, as seen in (13). It appears in precisely the same environments -- derived and non-derived -- in which other nasals occur.

4. Primary and Secondary Articulation -- Theoretical Approaches

A satisfactory general solution to the problem of nasal assimilation before labiovelars would have to answer the following questions:

1) How can some languages assimilate a nasal as [ŋ] and others as [ŋm]?
2) Why is it there are no attested cases of [m] before labiovelars?
3) How can we account for assimilation as [ŋ] *and* [ŋm] in the same language?

A more promising approach than either of the suggestions in Section 3 is to posit that a nasal assimilates in place to the more phonologically prominent of the two places of

articulation of labiovelars in some cases, and in other cases totally assimilates in place value. To do this, we need a theory in which the labial and the velar places of articulation may be treated as unequal.

Anderson (1976) claimed that labiovelars and other multiply-articulated segments must have primary and secondary articulations. He did this on the basis of the feature [anterior] in the SPE system. The reasoning was that a segment must be specified as either [+anterior] or [-anterior], corresponding to articulation in the front or back of the mouth, roughly speaking. In cases of multiple articulation, one articulator is generally at the front and one at the back of the mouth. By choosing [-anterior] to specify a multiply-articulated segment, we imply that the back articulation is the primary one; e.g. that is /kp/ is a labialized velar. Likewise, choosing [+anterior] implies that the front articulation is primary; /kp/ is then a velarized labial. In this view, there is no possibility of two primary articulations.

Anderson's basis for primary and secondary articulations has been undermined with the realization that the [anterior] feature is relevant only for coronals. However, the distinction is still a useful one, and various writers have attempted to bring it into a more current phonological representation.

Ryder (1987) was the first person I am aware of to bring out the distinction between languages in which nasals assimilate to [ŋ] before labiovelars versus those which assimilate to [ŋm]. Though not using a feature geometry approach, she nevertheless had some important insights on representing labiovelars within an autosegmental framework. Among these are that a language must be able to consider one place of articulation of a labiovelar to be dominant, as well as to treat them equally.

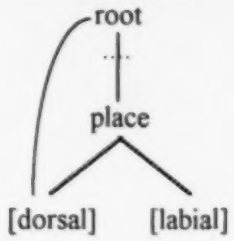
This insight was recognized as primary vs. secondary articulations by the writers cited below. It has only been with the emergence of a feature geometry framework (Clements 1985) that significant progress has been made in formally representing the distinction.

In all the representations below, I assume the nasal consonant has no underlying place specification, but will obtain a place value by spreading from the following consonant.

4.1 The Sagey model

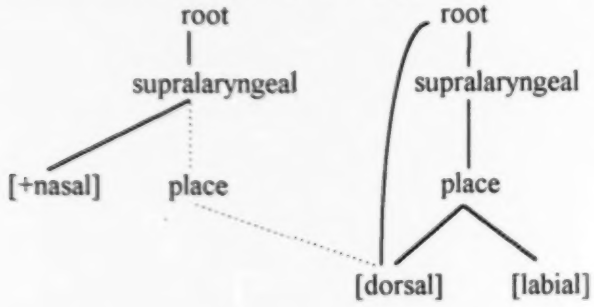
Sagey (1990) was the first to propose a feature geometry that dealt specifically with labiovelars and other complex segments. Her basic notion was that labiovelars had two places of articulation in underlying representation, which she symbolized using a [labial] node and a [dorsal] node. One of these would be the major articulator and one the minor. The major articulator was symbolized by a pointer from the root node to the appropriate articulator node. A partial representation of /kp/, assuming [dorsal] as major articulator, is:

(17) representation of /kp/ (partial tree)



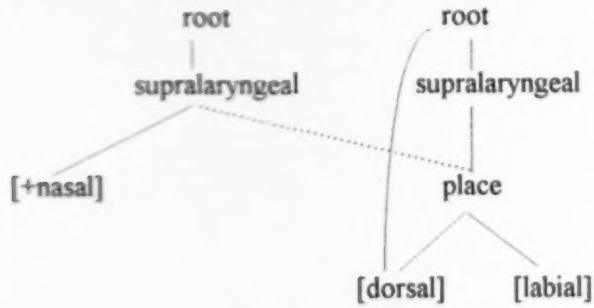
In this view, a partial place assimilation could take place between /kp/ and a preceding nasal consonant by spreading from the major articulator of /kp/ to the nasal:

(18) Partial assimilation of N to /kp/ (→ ŋkp)



Total place assimilation could also take place, by spreading from the place node of /kp/ to the nasal.

(19) Total place assimilation of N to /kp/ (→ ŋmkp)



Note that the above is not a case of crossing association lines, since the arc from root to [dorsal] is not an association line, but a pointer.

Sagey's proposed geometry thus can accommodate the Kɔnni nasal assimilation facts, by allowing spreading either from the major articulator node [dorsal], to yield [ŋ], or from the Place node, for total place assimilation [ŋm].

However, there is also nothing specified in the model that would prohibit spreading from the minor articulator node [labial] as well as the major articulator, giving cases of [mkp]. These do not seem to be attested. To prevent these, some sort of diacritic

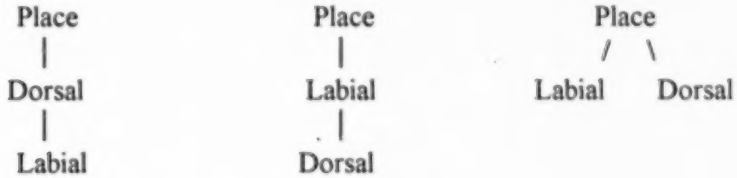
or condition would have to be imposed, saying that only a major articulator, as indicated by the pointer, could spread. However, in terms of the theory, this is rather arbitrary.

4.2 The Selkirk model

An assumption of most researchers is that tree structure is invariant and universal. Under this assumption, a segment that exhibits variant behavior across languages may be differentiated by some parts of the structure being unfilled for various features from one language to another, but the tree structure remains the same.

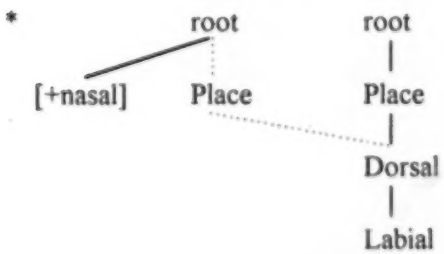
Selkirk (1993), in contrast, maintains that the actual dominance relations of features may vary if the language demands it:

(20) a) [dorsal] primary b) [labial] primary c) both primary



If the Dorsal place is primary, it dominates Labial; if Labial is primary, it dominates Dorsal, which is the logical arrangement. If both are primary, then neither dominates the other. So rather than have what amounts to a diacritic mark to indicate primary and secondary, the distinction is built into the geometry. In the case of Kɔnni , I have assumed above that [dorsal] is primary, and so in Selkirk's terms, (20a) should be the representation. However, this cannot represent the Kɔnni or other languages' facts accurately, but (20b) can. To see why this is so, consider possible derivations of [ŋkp]:

(21) Attempted assimilation of N to /kp/ (→ ŋkp), using (Xa):

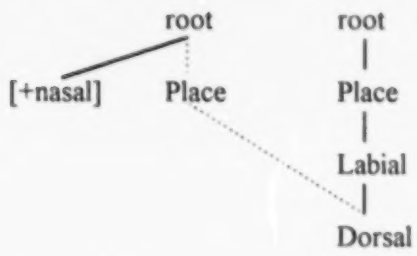


Above, we see that to spread the Dorsal node, as would be required for an output of [ŋ], also requires spreading of the Labial Node, since Labial is dominated by Dorsal. The result would be, not [ŋkp], but [ŋmkp], a total place assimilation. If we attempted to spread from the Labial node, the result would be [mkp], not attested at all in Kɔnni .

We would assume that if partial place assimilation occurs, a nasal would assimilate to the major place of articulation of the following consonant. However, if we use what Selkirk has labeled with [dorsal] as the major place, then we get the wrong form.

On the other hand, if we try (20b), we can derive the correct results of a partial assimilation to [ŋ] by spreading from Dorsal:

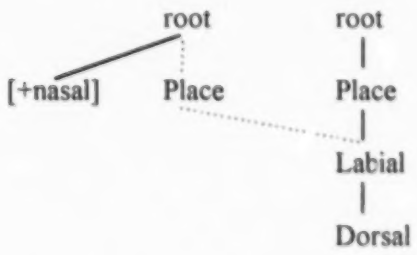
(22) Partial assimilation of N to /kp/ (→ ŋkp), using (Xb):



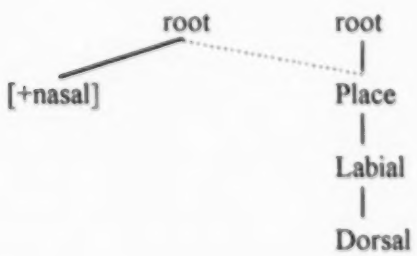
So either a nasal assimilates to the *minor* place of articulation, or Selkirk's model has the major and minor nodes reversed, or there is something fundamentally incorrect about her model.

Interestingly, total place assimilation of the nasal can be accomplished in Selkirk's geometry in either of two ways, either by spreading from Labial, which carries along the Dorsal articulation, or by the more traditional means of spreading from the Place node:

(23) Total place assimilation of N to /kp/ I (→ ŋmkp):



(24) Total place assimilation of N to /kp/ II (→ ŋmkp):



Thus there is a definite ambiguity in the Selkirk model applied to the Kɔnni data.

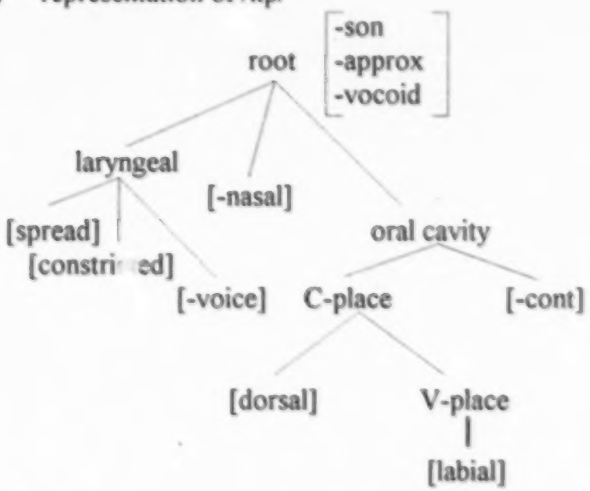
To sum up, the Selkirk model can account for the facts of Kɔnni and other languages, if we reverse Selkirk's labeling of what is major and minor. But this does not

seem to be desirable, since we would expect a major articulator to dominate or at least be higher in the tree than a minor one. And the point that a total place assimilation is accomplished in two distinct ways is also unfavorable. Finally, the point that either Dorsal may dominate Labial, or vice-versa, or neither, makes the theory not as constrained as desirable.

4.3 The Clements and Hume model

Clements and Hume (1993) , hereafter C&H, propose a different geometry of features, based not on physiological articulators, as Sagey does, but rather on areas of constriction in the vocal tract. This includes a geometry for dealing with secondary articulation such as palatalization and labialization. C&H state (1993:38) that the major articulation feature is always the superior node in the hierarchy. Thus their model, like Selkirk's, builds the distinction between major and minor articulations into the geometry itself, rather than adding what amounts to a diacritic feature, the pointer, as Sagey's model does.

(25) representation of /kp/

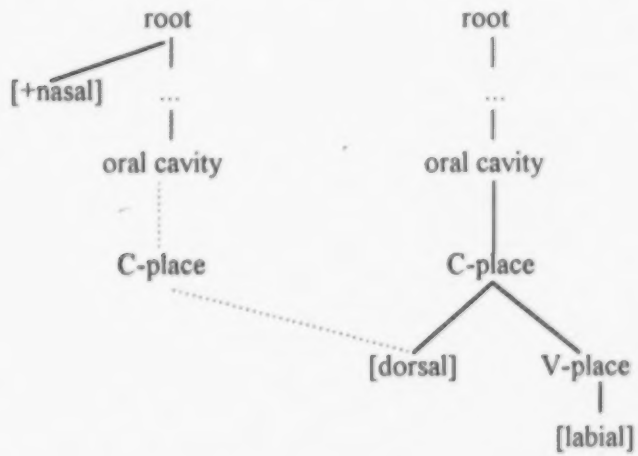


Above, the primary articulation of /kp/ is the [dorsal] node, structured as a daughter of the C-place node. The [labial] constriction, which is secondary, is not represented as a daughter of C-place, but is assigned down the hierarchy, dominated by the V-place node. In the C & H model, all vowel features are dominated by V-place, which itself is dominated by C-place. Secondary articulations are also dominated by V-place, even though they are articulations of a consonant.

An assumption in much of the literature is that secondary place features represent the superimposition of vowel qualities on consonants and thus are identified with vowel features (cf. Ní Chiosáin 1994, fn. 1). That is, labialization involves some of the features of [u], palatalization some of the features of the features of [i], etc. In the C&H model, this can be true as well, but features on V-place are used for secondary articulation of consonants in general. So the secondary articulation of a [kp] though firmly consonantal in nature, may still be represented under V-place.

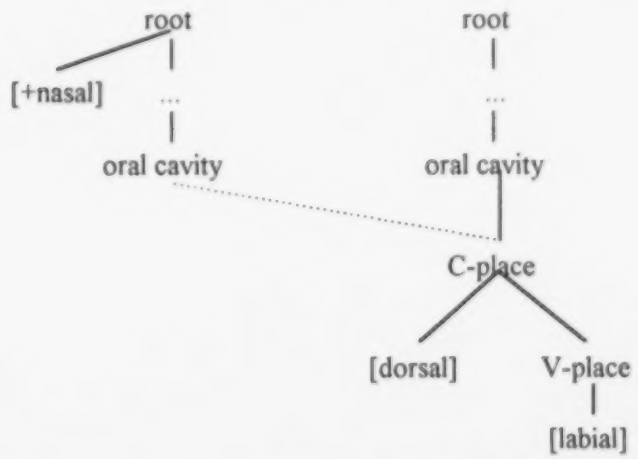
The C&H model's representation of a partially assimilated nasal before /kp/ is:

(26) Partial assimilation of N to /kp/ (→ ŋkp):



A total assimilation of a nasal to /kp/ is accomplished as follows:

(27) Total place assimilation of N to /kp/ (→ ŋmkp):



This model has significant advantages over the previous two models. It defines primary and secondary articulations structurally, rather than depending on a diacritic device like Sagey's pointer. Like Selkirk's model, it naturally places the primary articulation higher in the hierarchy than the secondary one, but unlike Selkirk's, the C&H model actually works with the primary and secondary articulations in these positions.

One crucial difference is that the secondary articulation is positioned under V-place and not directly under C-place. A rule of assimilation referring to the place of articulation *of the consonant* can refer only to features directly linked to C-place (and will

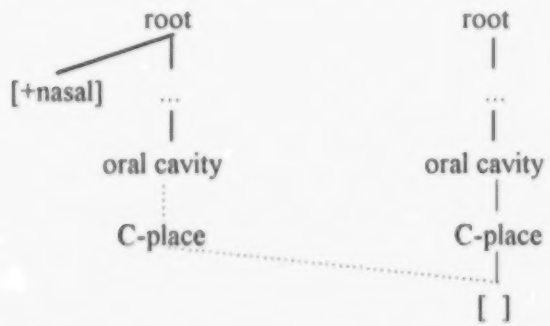
be formulated in the next section). So the C&H model can accomodate both partial and total place assimilations in a principled way.

5. A Solution

Building on the C&H model of representation, we can set out a satisfactory solution to the Kɔnni and other language data. This depends on formulating two distinct rules of nasal assimilation, one for assimilation to the major place of articulation of a consonant, and one to the C-place node.

The first rule, which accounts for a nasal assimilating to a following labiovelar as [ŋ], is as follows:

(28) Nasal Assimilation to Primary Place (NAPP)

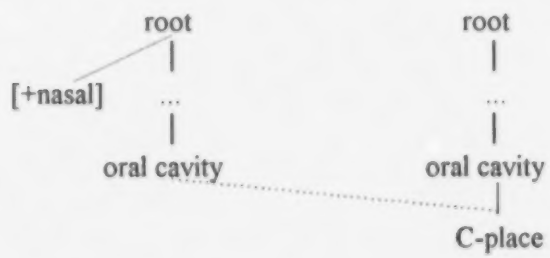


Rule (28) (NAPP) says that a nasal consonant preceding another consonant will take on the primary place of articulation of the second consonant. The empty brackets stand for whatever place is present - Dorsal, Labial, Coronal, or any other possibility. For most consonants, this will be the only place of articulation. However, if a consonant has a secondary place of articulation, this will not affect the nasal at all. In the case of a labiovelar with primary place Dorsal and secondary place Labial, the nasal assimilates only to Dorsal, which gives [ŋ].

NAPP accounts for those languages in which a nasal assimilates to /kp/ as [ŋ].

The second nasal assimilation rule is needed for languages in which a nasal completely assimilates to the place of /kp/, that is, as [ŋm].

(29) Total Nasal Assimilation (TNA)



Rule (29) (TNA) says that a nasal consonant preceding any other consonant will assimilate totally in place of articulation to that following consonant. Note that the spreading is from the C-place, which will include not only the primary place of articulation, but any secondary one, should it be present.

TNA accounts for those languages in which a nasal assimilates to /kp/ as [ŋm].

Note that in their present form, the two nasal assimilation rules predict different results for nasal assimilation not only to the labiovelars /kp, gb/, but also to labialized velars such as /k^w/, palatalized consonants such as /b^j/, and any other consonant with secondary articulation. In those languages which assimilate /N/ to a labiovelar as /ŋ/, only the primary articulation spreads. So if any of those languages have phonemes with secondary articulation, the approach in this paper predicts nasals will only assimilate to primary places of articulation.

On the other hand, if a language assimilates /N/ to a labiovelar as /ŋm/, all places of articulation spread. If any of these languages have phonemes with secondary articulation, the prediction is that nasals will assimilate to the secondary as well as the primary articulations (though there may be some constraints on what is allowed phonetically).

For the case of Kɔnni, both rules of nasal assimilation apply. NAPP applies as a lexical rule, perhaps at more than one stratum, giving the correct output of [ŋ] within words. TNA applies as a postlexical rule, giving the output of [ŋm] across words. Unfortunately, Kɔnni has no other consonants with secondary articulation, so the prediction mentioned above will have to wait for data from other languages.[6]

6. Explanations, implications, and conclusion

Questions we have sought an answer to in this paper were:

1) How can some languages assimilate a nasal as [ŋ] and others as [ŋm]?
2) Why is it there are no attested cases of [m] before labiovelars?
3) How can we account for assimilation as [ŋ] *and* [ŋm] in the same language?

The answer to questions 1 and 3 turned out to be the same. There are two processes of nasal assimilation, one total and one partial. A language can use one rule or the other or both. We have noted that there do not seem to be any cases of [m] before labiovelars, and in the light of the preceding discussion, we can add a related question to number 2 above:

4) Do labiovelars inherently and universally have one place of articulation that is more phonologically prominent than another?

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[6] Data from Irish (Ni Chiosain 1991, as reported in Clements and Hume 1993) are similar to Kɔnni in that Irish also has two modes of nasal assimilation, one in which the priary and secondary (palatalization, in this case) articulations of the following consonant is spread to a nasal, and one in which only the primary is spread. Not having seen Ni Chiosain's dissertation, I can but speculate, but the Irish data I have seen could be accounted for by the NAPP and TNA rules given here.

6.1 A phonetic explanation

In dealing with the phonological representation of labiovelars, I still have not answered the question of why there are no attested cases of [m] before labiovelars.

As far as phonological geometry goes, there is no real explanation of why a Dorsal node should be more dominant than a Labial node. However, there is a natural explanation in terms of the acoustic phonetics of labiovelars.

Ohala & Ohala make the point about the commonality of [ŋ] rather than [m] before labiovelar stops in their Theorem D:

> Doubly articulated nasals, e.g. [ŋm] and the nasal assimilating to the following labiovelar stops, will tend to pattern with consonants sharing the rearmost place of articulation rather than the frontmost. (1993:235)

The reason for this is easy to see. [ŋm] has two places of articulation: a front [m] and a rear [ŋ]. In the resonating cavity which is composed of the oral and nasal tracts, [ŋm] creates a complete constriction which is identical to that when [ŋ] is pronounced. It is this rearmost constriction that defines the length of the oral part of the resonating cavity. As the Ohalas say, "Any additional constriction forward of that point is acoustically irrelevant." (p.236).

The point is that acoustically, the labiovelar [ŋm] and the velar [ŋ] have basically identical spectra, while [ŋm] and [m] are significantly different. Assuming a complete assimilation ([ŋm]) as a starting form, it could historically simplify to [ŋ] on the basis of its acoustic properties. Acoustically, there would be very little change.

Parenthetically, this is why both aural and visual input are necessary to accurately transcribe these nasals. From the ears alone, [ŋm] and [ŋ] are identical. By sight, both [ŋm] and [m] have labial closure.

In light of the previous phonological analysis, the seeming lack of [mkp], and the above phonetic supplement, I propose that the representation of /kp/ in (25), repeated below, is the universal, or at least areal, representation of a labiovelar consonant.[7]

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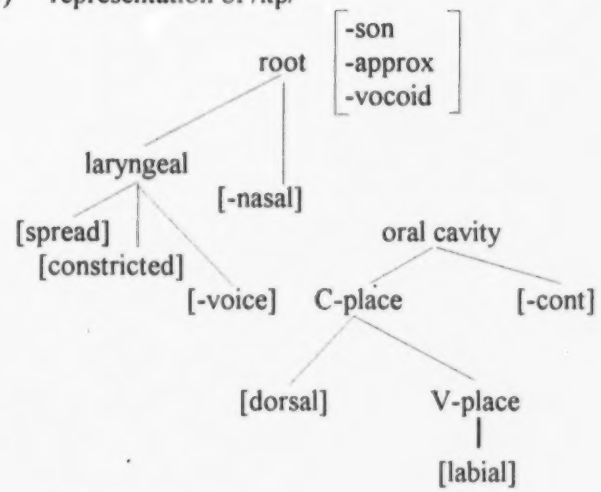
[7] One possible reason for positing (25) as areal rather than universal is the behavior of /gb/ in the Amele language of Papua New Guinea (Roberts 1987). In Amele, unlike the African languages cited here, /gb/ may occur word-finally, in which case it and /b/ are neutralized, both being realized as [p]. In Amele, then, the labiovelar patterns with a labial consonant, and so presumably has Labial rather than Dorsal as a major articulator. However, the facts are sparse and so I must leave the question open for the time being.

(30) representation of /kp/



6.2 What about /w/?

One might wonder how much of the above discussion would apply to the glide /w/, which shares the characteristic with /kp/ of having two places of articulation. As Welmers notes,

> Homorganicity is ambiguous in the case of nasal plus [w], since [w] has both bilabial and velar articulation. Thus [mw] in some languages, and [ŋw] in others, may equally represent homorganic clusters. Fante even has [nw]; for Fante, the pattern of nasal plus consonant may be stated as involving homorganicity with the predominant articulation *if any* [author's emphasis], or otherwise [n]. (Welmers 1973:65)

Recall that Anufo (9) had N assimilate to /kp/ as /ŋ/; all the data was within words. Similarly, Anufo /N/ assimilates to /w/ as [ŋ]:

(31) Anufo (Chakosi) (Stanford 1970)
ŋwɛ̃ 'mother's brother'

One might be tempted to group /w/ with /kp, gb/ as far as labiovelar behavior, However, Kɔnni /N/ assimilates to /w/ as /ŋ/ also, even across words, where /N/ assimilates to /kp/ as /ŋm/:

(32) ŋ wó ˈjááŋ 'I lack (the) thing.'

So /w/ in Kɔnni, at least, acts differently than /kp/. What the precise nature of the difference is will have to await more research.

6.3 Conclusion

To account for the facts of nasal assimilation in Kɔnni and other languages, a geometrical representation must allow for both partial and total place assimilation. The facts of nasal assimilation suggest that a partial place assimilation is not unrestricted, but assimilates to the primary place of articulation if the language makes a distinction between primary and secondary places.

The Clements and Hume model of geometric representation, together with two separate rules of nasal assimilation, accounts for the facts better than either the Sagey or Selkirk model.

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